Water Efficient Irrigation Program Evaluation
1995 - 1998

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Abstract

Seattle Public Utilities and its wholesale customers have operated the Water Efficient Irrigation Program for over four years. This program helps large commercial irrigators by identifying and funding irrigation improvements. So far, through capital improvements alone, the program has achieved water savings of more than 117,817 gallons per day (gpd), at a cost significantly less than the utility's cost for new water supply. (The gpd is for the entire year) Customers often receive additional benefits such as reduced labor costs and improved landscape health.

The program provides participating customers with 1) a site assessment or audit, 2) a written recommendation, and 3) a financial incentive payment to carry out the capital improvement recommendations. Many types of large irrigators have participated in the program, including cemeteries, multifamily complexes, office parks, public parks, and schools. Water savings per customer range from an average of 2,000 gpd for public parks to 30,000 gpd for cemeteries, with bill savings from $800 to $12,000 per year. As a result of the capital improvement work from 1995-1998, the program projects saving 117,817 gpd over 15 years at a levelized cost of $0.58 per ccf. (hundred cubic feet) This means that the total cost of the program, including labor, consultant fees, and capital improvement incentives have bought 117,817 gpd in savings at $0.58 per ccf over the expected cost of $2.13 per ccf for a new source of water supply.

History and Background

In addition to providing water for the City of Seattle, Seattle Public Utilities (SPU) sells water to 26 wholesale water purveyors in surrounding cities and communities. The total service population is approximately 1.3 million people. Approximately half of SPU's customers reside within purveyor communities. The City of Seattle provides water conservation services to the 26 purveyors, including offering financial incentives to improve or replace water using equipment.

The program began in 1991 when the former Seattle Water Department (now called Seattle Public Utilities) piloted a computerized irrigation central control water conservation program. Seattle Water bought 4 computerized systems and distributed them to: Jefferson Golf Course and Woodland Park Zoo in Seattle; and a suburban School District and Parks Department. Seattle Public Utilities also bought weather stations for the City of Bothell, Jefferson Golf Course, and Seattle Center. Although no baseline study occurred for a "before and after" analysis, all customers report high satisfaction with the computerized central control and intuitive water savings. Analyzing Jefferson Golf's water use in 1995 demonstrated the golf course generally waters according to the weather conditions and evapotranspiration which is the goal of centralized control.

An irrigation water conservation program began at the end of 1992. In 1993, Seattle hired an irrigation contractor to conduct a series of trainings for irrigation industry workers. The courses were on irrigation system auditing and becoming a Certified Landscape Irrigation Auditor (CLIA); and Irrigation System Maintenance and Repair. The premise of CLIA training was that these individuals could borrow the equipment from Seattle Water and audit irrigation systems (Seattle Water has 3 audit kits). Approximately 50 people received CLIA status through this process.

Concurrently in 1993, Seattle Public Utilities' Water Smart Technology program began offering financial incentives to commercial customers installing water efficient commercial/industrial equipment, including irrigation. However there was no irrigation rebates the first year. During 1994 the irrigation water conservation program designed a pilot program offering irrigation system audits and financial rebates.

Program Description

In 1995 the Water Efficient Irrigation Program began. The program structure is:

Site Eligibility: Commercial Site with irrigated landscape (a minimum of 1 acre)

Program components:

- Site Assessment or Audit: Seattle Public Utilities (SPU) staff or consultant will visit the site and conduct an assessment of the irrigation system. Occasionally staff will conduct an actual audit where appropriate. Additional information on management of the system, such as sprinkler run times and maintenance practices, is gathered

- Written recommendations: After the site assessment, SPU staff will write up a list of recommendations for improving the water efficiency of the system. The reports generally have two components: management improvements and capital improvements. The management improvements are recommendations for changes in the management of the system that will save water. The capital improvements are actual replacements of the irrigation system hardware with more water efficient equipment. Attachment A is an example of the cover letter SPU writes for the customer's report.

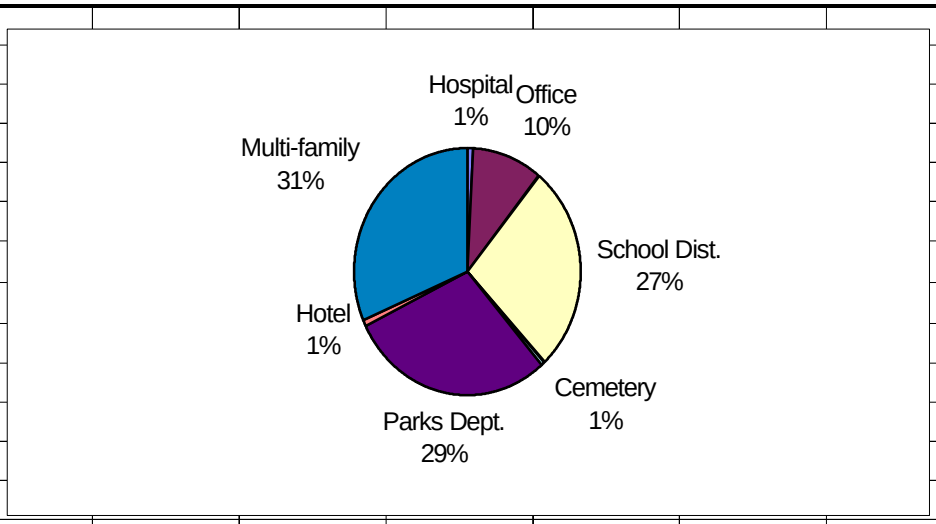
- Financial Incentives: Customers can apply for financial incentives for any improvement that saves water. Sites make many improvements based on the Site Assessment recommendations. However some sites make retrofits without prior recommendations. A site assessment is not a requirement for a financial incentive payment.

Summary of customers

Attachment B outlines every customer served from 1995 - 1998 and summarizes the work done for each customer. The next two tables summarize customers served over the 4 years of the program.

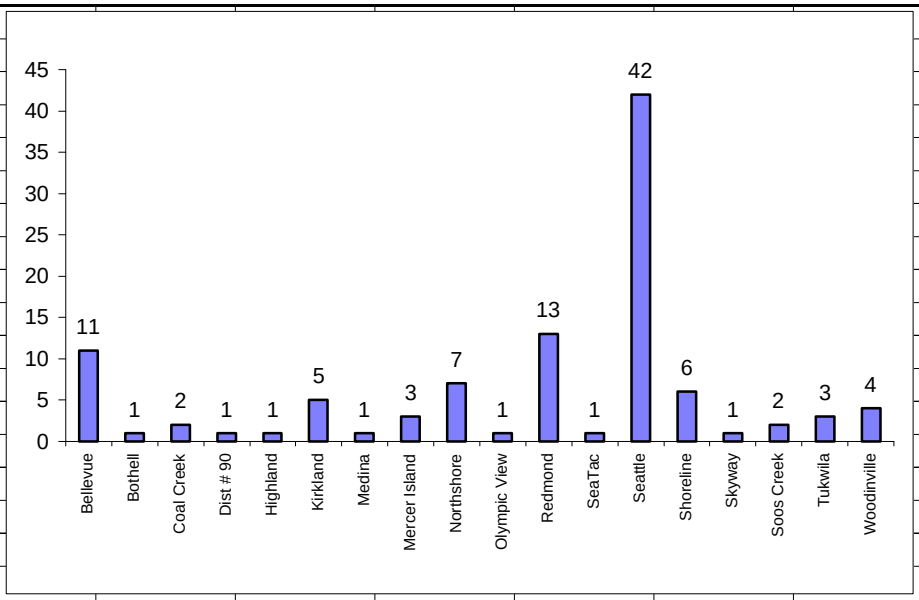
Number of sites by type of facility: This covers all sites, including every Seattle park under one participation agreement and every school under one school district's participation agreement.

Hospital	1
Office	14
School Dist.	37
Cemetery	1
Parks Dept.	40
Hotel	1
Multi-family	43
Total	137



Number of customers by water district: This mostly covers single encounters, therefore a single participation agreement covering several parks or schools is only counted once. The exceptions are King County Parks and Shoreline School District. Since they covers several cities, each city under one participation agreement was counted once. This table attempts to demonstrate the breath of customer service through out Seattle and purveyor areas.

Bellevue	11
Bothell	1
Coal Creek	2
Dist # 90	1
Highland	1
Kirkland	5
Medina	1
Mercer Island	3
Northshore	7
Olympic View	1
Redmond	13
SeaTac	1
Seattle	42
Shoreline	6
Skyway	1
Soos Creek	2
Tukwila	3
Woodinville	4
TOTAL	105



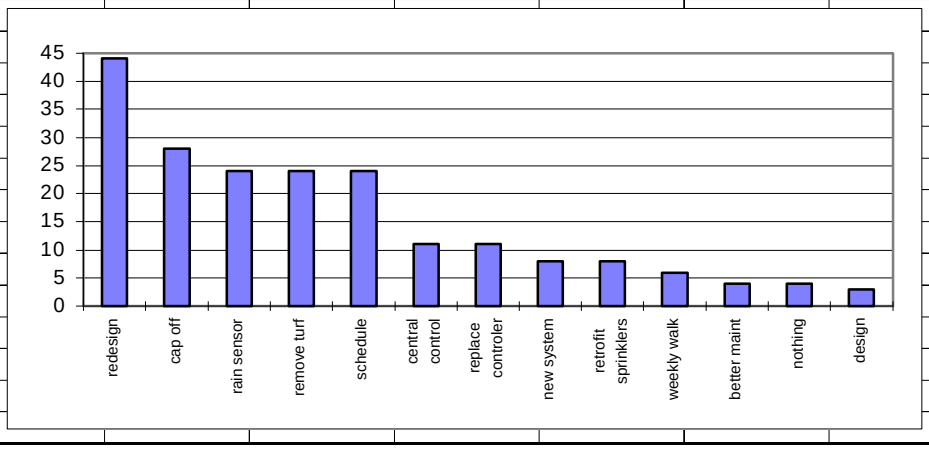
Site Assessments / Audits

A "Site Assessment" requires an irrigation evaluator (consultant or SPU staff) asking the site representative questions about management of the system and observing the system in operation. Usually a catchment test is performed. After evaluating the site's irrigation practices and equipment, SPU writes a set of recommendations. The assessment breaks down water saving advice by "Maintenance and Operation Suggestions" and "Capital Improvement Suggestions." Between 1995-1998, SPU visited 97 different sites through out the region.

Assessments Findings: The Site Assessment's recommendations developed a pattern over time, and the reports became fairly standard. The following table lists the recommendation categories and number of times given. Most Site Assessments received more than one recommendation:

Recommendations:

redesign	44
cap off	28
rain sensor	24
remove turf	24
schedule	24
central control	11
replace controler	11
new system	8
retrofit sprinklers	8
weekly walk	6
better maint	4
nothing	4
design	3



Many of the systems were in poor condition and the best recommendation for water efficiency was a complete redesign of the system. After that, capping off unnecessary sprinkler heads is a quick and inexpensive method of saving water. Although Seattle is a rainy area, SPU recommended 24 sites install rain sensors. Setting an appropriate irrigation schedule is vital to saving water during the cooler months. Since irrigation technology continues to dramatically improve, replacing older irrigation controllers is recommended. Removing turf from unneeded areas, such as steep slopes or small areas between walkways, is another recommendation. Replacing turf with another low water using plant or even no plant material saves water and maintenance time.

Improvements

In order to qualify for a financial incentive, the customer fills out an application explaining the water saving improvement and attaches a bid or cost from a contractor or supply store. SPU evaluates the water use at the site and determines whether the improvement saves water through establishing a

"Water Budget." SPU takes the amount of water used at a site and subtracts the amount of water the site should be using if it maximized efficiency (what a Water Budget determines). This amount is the potential water savings.

SPU signed 30 participation agreements for capital improvements over the 4 years and distributed funds to 28 sites. The total amount paid out was $245,191.42.

The type of projects funded through financial incentive were:

Type of Improvement	Number of Improvements	Total SPU Incentive	Total CCF Savings / Year	Total Levelized Cost / CCF
Submeter	1	$ 3,084	935	$0.55
Remove turf and sprinklers	1	$ 2,750	471	$0.98
Retrofit system	9	$ 43,734	6,181	$1.19
Install new system	3	$ 37,590	5,479	$1.13
Double check valve	1	$ 2,550	231	$1.85
New controller	2	$ 2,786	2,992	$0.17
Connect to Central Control	4	$ 32,386	6,153	$0.87
Central Control	5	$111,862	24,218	$0.76
Cap-off sprinklers	2	$ 8,450	9,081	$0.17

Installing new controllers and capping-off unneeded sprinklers appear as the most cost effective improvements. The region's major parks departments both participated in the program though purchasing computerized central control systems. A suburban school district was another active participant who also purchased a computerized system. Making generalizations from the single improvements is not advised.

Total Program Expenses:

	1995	**1996**	**1997**	**1998**
Salary (.6 FTE) (+ benefits)	$ 31,600	$ 32,600	$ 33,600	$ 33,600
Other expenses	$ 3,380	$ 11,694	$ 8,220	$ 9,587
Incentives	$ 13,072	$ 75,956	$ 61,885	$ 94,279
Total	$ 48,052	$120,250	$103,705	$ 107,226

Water Savings

Evapotranspiration: Evapotranspiration (ET) determines how much supplemental water plants need. ET is the amount of water that has evaporated and transpired from a crop and therefore needs replacement.[1] ETo reflects adjusted ET to match the conditions of a site. For example, some turf may only need 80% ET to maintain its health and appearance, therefore ETo would be 80% of ET.

[1] This is an over simplified explanation of ET. For the needs of SPU, this loose definition will suffice.

Weather stations monitoring the different environmental elements that evaporate and transpire water from plants measure ET. SPU has access to six different regional weather stations and has actively tracked ET since May 1996. ET measures supplemental water demand in inches.

1998 Evapotranspiration Rates for Greater Seattle Area (in inches):

	Redmond	*Bothell*	*Seattle Ctr.*	*Jefferson GC*	*Woodinville*	*Microsoft*	*Sand Point GC*
*April**	2.83	0.82	3.28	2.74	1.08	2.53	0.92
May	3.28	2.49	3.18	2.61	3.62	2.56	2.85
June	4.14	3.41	4.15	3.71	4.46	3.36	3.78
July	5.2	4.34	4.86	4.7	5.55	4.33	4.85
August	5.05	3.97	4.22	4.37	5.27	4.11	4.5
September	3.81	2.69	3.49	3.33	3.46	2.74	3.41
October	1.68	0.99	1.92	1.23	0.74	1.11	1.34
Totals	25.99	18.71	25.1	22.69	24.18	20.74	21.65

(Bothell, Woodinville, and Sand Point's April data is for April 24-30 only.)*

Regionally the ET rates differ as well. Solar Radiation affects the ET rate the most. Sunlight will drain more water from a plant than temperature, humidity, or the wind velocity. The ET for a single site will change by microclimate and shading and sun exposures have tremendous effects on a plant's need for water. This discussion of ET intends to demonstrate the variance of ET over the years and region. Some years, irrigation demand is higher than others.

Summary of Water Savings: Analyzing irrigation water use data for most sites participating in the WEIP program from 1995-1997 (1998 still needs analysis) demonstrates water savings comparable to the amount predicted. When analyzing the results, consider two factors: 1) Continued evaluation of irrigation use at these sites will be necessary in order to follow the effectiveness of this program over time; 2) *Calculating the levelized costs of this program does not consider the customers who only received a site assessment* . Therefore the estimated water saving is conservative.

Between 1995 to 1997:

1. The average savings for sites investing in capital improvements: 1,171 ccf

2. The average water savings for site assessments only (no capital improvements): 1,232 ccf

3. The average water saving by type of site per year is:
   - Cemetery: 6,106 ccf
   - Multifamily: 827 ccf
   - Office park: 1,156 ccf
   - Park: 417 ccf
   - School: 1,126 ccf

Conclusion for 1995 - 1998

Cost effective: This program is cost effective based strictly on financial rebates used to buy water savings. The levelized cost per ccf of water savings is $0.58 per ccf compared to the avoided cost of $2.13 per ccf. *This accounts for all program costs including staff salary and consultant dollars*. Because irrigation only occurs during the summer, this program has an added benefit of specifically reducing peak season water consumption.

Site assessments alone save water: It appears that site assessments alone are an effective tool for landscape irrigation water savings. When SPU noted a broken head during a site assessment, for example, the owner was able to fix it immediately rather than let it continue to waste water. Often owners do not observe the sprinklers in operation because the sprinklers run at night. One recommendation SPU makes is for site managers to regularly observe the sprinkler system in operation. The site assessments demonstrated to many managers the benefit of this practice

Customer based services: Seattle Public Utilities' water savings success is realized through operating a customer based water irrigation conservation program. The three major elements that have lead to success are:

- Site Specific: visit each site and tailor the recommendations to the site.

- Recommend both Management Improvements and Capital Improvements: Good management of an irrigation system is the key to water efficiency. After the site improves maintenance practices, then capital improvements will have the greatest effect.

- Use Visuals: Many financial decision makers do not see the problems in the irrigation system. Therefore when they read report, pictures help decision makers visualize the problems. This helps connect the written recommendations with the actual problem.

Recommendations for 1999 and beyond

The change in this program's emphasis is apparent over the 4 years. At first SPU emphasized capital improvements, but realized that the problems in irrigation are too difficult to solve with one incentive payment. During site assessments the program identified the same basic problem: a poor irrigation installation and subsequent management. This leads to the conclusion that a transformation of the way Seattle thinks of irrigation is fundamental to any real impact on summer peak water savings.

Therefore SPU recommends focusing on Management Improvements first but does not dismiss the effectiveness of capital improvements. Capital improvements should be standardized for easy access, as sort of "cook book" of improvement options, however not be the focus of the program. The two approaches are outlined below.

Management improvements approach:
The most critical element to using water wisely in irrigation is the evaluation of irrigation systems. The evaluations and audits result in improved irrigation scheduling. An improved irrigation schedule adjusts the sprinkler run times based on the time of year, type of sprinkler, type of plant material, type of soil and overall landscape needs. The CPA estimates improved irrigation scheduling can save up to 462,376 gpd during the peak season.

In order to work towards this level of savings, SPU should retain one or two landscape and irrigation consultants at a cost of $25,000 per year. The consultants will focus on an expanded marketing program to specific elements in the landscape industry. The consultants will also provide landscape site assessments obtained from the marketing.

The enhanced level of service will emphasize improved design, installation, and management of irrigation systems. Working cooperatively with the irrigation industry will enhance SPU's ability to educate industry professionals and property owners. This will result in more irrigation systems with proper schedules. The cooperation with the landscape industry can take several forms:

1. Work with the Irrigation Association and other landscape trade associations to sponsor industry training, such as natural lawns certification.
2. Work with designers and architects on how to design irrigation systems.
3. Meet with the Association of Landscape Architects on irrigation issues.
4. Promote and encourage professionals to become certified water managers.
5. Work with the industry on state licensing of irrigation installers similar to Texas, New Jersey and Oregon's laws.
6. Develop an irrigation efficiency award program.

Capital improvements approach:
Only 28 out of the 105, or 27% of the contacts result in a customer accessing the financial incentives. Of the 28 financial incentives distributed, only 6 types of improvements were frequently installed. From SPU's experience in both site assessments and distributing financial incentives, the recommendation is to standardize an incentive payment for these capital improvements: modern controller, rain shut off, connection to central control, and cap-off sprinklers. More research will be conducted to determine a standard level of payment. Research on the following improvements will occur for future consideration: soil moisture sensor, drip irrigation retrofit.

The traditional incentive program will still be available, but will not be emphasized. SPU will only encourage incentives for customers who can fully take advantage of capital improvements outside the standardized improvements.

Through a focused effort to improve the quality of irrigation installation and easy and understandable payments for specific, cost effective improvements, the Water Efficient Irrigation Program will move into a new level of customer service and long term water savings.